ABSTRACT OF THE DISCLOSURE

A gas discharge laser crystallization apparatus and method for performing a transformation of a crystal makeup or orientation in the substrate of a workpiece is disclosed which may comprise, a multichamber laser system comprising, a first laser unit comprising, a first and second gas discharge chamber; each with a pair of elongated spaced apart opposing electrodes contained within the chamber, forming an elongated gas discharge region; a laser gas contained within the chamber comprising a halogen and a noble gas selected to produce laser light at a center wavelength optimized to the crystallization process to be carried out on the workpiece; a power supply module comprising, a DC power source; a first and a second pulse compression and voltage step up circuit connected to the DC power source and connected to the respective electrodes, comprising a multistage fractional step up transformer having a plurality of primary windings connected in series and a single secondary winding passing through each of the plurality of primary windings, and a solid state trigger switch; and a laser timing and control module operative to time the closing of the respective solid state switch based upon operating parameters of the respective first and second pulse compression and voltage step up circuit to effect operation of the first and second laser units as either a POPA configured laser system or a POPO configured laser system to produce a single output laser light pulse beam. As a POPA laser system relay optics may be operative to direct a first output laser light pulse beam from the first laser unit into the second gas discharge chamber; and, the timing and control module operates to create a gas discharge between the second pair of electrodes while the first output laser light pulse beam is transiting the second discharge region, within plus or minus 3 ns and as a POPO, combining optics combine the output beams, and timing creates pulse separation in the combined output a preselected time plus or minus 3 ns. A beam delivery unit and a pulse stretcher may be included, and timing and control may be processor controlled based on signals representing charging voltage and component temperatures in the pulse compression and voltage step up circuits.